REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR: 8707200004 DOC. DATE: 87/07/10 NOTARIZED: NO DOCKET #
FACIL: 50-250 Turkey Point Plant, Unit 3, Florida Power and Light C 05000250
50-251 Turkey Point Plant, Unit 4, Florida Power and Light C 05000251
AUTH. NAME AUTHOR AFFILIATION
WOODY, C. O. Florida Power & Light Co.
RECIP. NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Forwards addl info re continued use of Boraflex at facility, per 870609 request. Boraflex is neutron absorbing poison used in spent fuel racks, assuring shutdown margin of 5% w/no boron in spent fuel pool water.

DISTRIBUTION CODE: A001D COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 16
TITLE: OR Submittal: General Distribution

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD2-2 LA	1	0	PD2-2 PD	5	5
	McDONALD, D	1	1			
INTERNAL:	ARM/DAF/LFMB	1	0	NRR/DEST/ADE	1	1
	NRR/DEST/ADS	1	1	NRR/DOEA/TSB	1	1
	~~NRR/PMAS/ILRB~~	1	1	OGC/HDS2	1	0
	REG FILE 01	1	1	RES/DE/EIB	1	1
EXTERNAL:	EG&G BRUSKE, S	1	1	LPDR	1	1
	NRC PDR	1	1	NSIC	1	1

Add:	Ltr	Encl
NMSS/SGOB	1	1
NRR/DOEA/EAB	1	1
NRR/DREP/EPB	1	1
NRR/DREP/RPB	1	1

TOTAL NUMBER OF COPIES REQUIRED: LTTR ~~19~~ 23 ENCL ~~16~~ 20

P. O. BOX 1400 JUNO BEACH, FL 33408-0420

FPL

JULY 10 1987
L-87-279

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Re: Turkey Point Units 3 and 4
Docket No. 50-250 and 50-251
Request for Additional Information
Boraflex Usage at Turkey Point

Attached is Florida Power & Light Company's response to your June 9, 1987 request for additional information concerning the continued use of Boraflex at Turkey Point.

Should there be further questions, please contact us.

Very truly yours,

C. O. Woody
Group Vice President
Nuclear Energy

COW/RG/gp

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant

A001 Add: NMSS/SGOB Ltr Encl 1 1
NRR/DoEA/EAB 1 1
NRR/DREP/EPB 1 1
NRR/DREP/RPB 1 1

RG3/049/1

Question 1 — Based on the recent experience pertaining to degradation of Boraflex in spent fuel pools at Quad Cities and Point Beach Nuclear Power Plants, provide justification to demonstrate the continued acceptability of Boraflex for application in the Turkey Point spent fuel pool.

Response — Boraflex is the neutron absorbing poison used in the Turkey Point spent fuel racks. This material assures a shutdown margin of 5% with no boron in the spent fuel pool water.

As discussed in Section 4.7.2 of the Turkey Point Units 3 and 4 Spent Fuel Storage Modification, Safety Analysis Report, dated March 14, 1984, Boraflex has undergone extensive qualification testing to study the effects of gamma and neutron irradiation in various environments and to verify its structural integrity and stability as a neutron absorbing material. These tests indicated that Boraflex maintains its neutron attentuation capabilities when subjected to an environment of borated water and 1.03 x 10^{11} rads gamma radiation. Additionally, further tests have recently been conducted and preliminary results indicate that some shrinkage (a maximum of about 2%) can occur in Boraflex,

and that this shrinkage is complete at approximately 1×10^{10} rads gamma.

Three plants have reported the results of their first Boraflex surveillance. Of these three, the Boraflex material used at Point Beach Nuclear Power Plant has received the highest accumulated dose. This Boraflex material has been in use for a total of five years, and some of the Boraflex panels have received a 20 year-equivalent radiation dose due to the spent fuel management techniques used at Point Beach. The examination of the 2" x 2" sample coupons at Point Beach (which had a maximum exposure of 1.6×10^{10} rads gamma) showed that the coupons had experienced changes in physical characteristics such as color, size, hardness, and brittleness. However, the nuclear characteristics of the samples had not experienced any unexpected changes, and the boron absorbing properties of the samples met the acceptance criteria for maintaining the 5% Δ k/k shutdown margin. Point Beach also examined two full size (150" long x 8" wide) Boraflex panels, which had a maximum exposure of about 1×10^{10} rads gamma. These panels had a far lesser amount of physical changes than the 2" x 2" sample coupons. Thus, the examination of the Point Beach

coupons and Boraflex panels indicates that, while some physical changes in Boraflex may occur with accelerated radiation exposure, the Boraflex will retain its neutron absorbing characteristics.

Prairie Island has also examined two large (8" x 12") Boraflex coupons. One of the coupons (which had a 6 month exposure) had an appearance similar to the as-manufactured Boraflex. The other coupon (which had a 12 month exposure) had some slight physical changes similar to that experienced by the Boraflex panels at Point Beach.

The Boraflex panels in the Quad Cities racks (which had an exposure of about 10^9 rads gamma) were examined by a neutron surveillance technique. Gaps were noted in the Boraflex panels, and review of the size and number of gaps was performed. This review indicated that the gaps were attributed to a rack design and fabrication process which did not allow the Boraflex to shrink without cracking. The Quad Cities racks were designed to hold smaller BWR fuel and did not utilize a protective wrapper for installing the Boraflex. The fabrication process required the Boraflex material to be glued and firmly clamped in place to the stainless steel

fuel rack walls. This process did not allow for the predicted shrinkage of Boraflex and as such gaps developed. Additionally, the Boraflex panels at Quad Cities were not constructed from a single sheet of Boraflex, resulting in pre-existing breaks in the Boraflex panels. Less than half of the Boraflex panels at Quad Cities had gaps. Furthermore, the gaps in the Boraflex panels at Quad Cities varied in length up to a maximum of 4" and were located at various places along the heighth of the panels. A k-effective analysis of the Quad Cities spent fuel pool demonstrated that these gaps did not cause Quad Cities to exceed its 0.95 limit on k-effective.

Turkey Point racks are designed to hold the large PWR fuel assemblies. Boraflex panels were constructed from a single sheet of Boraflex and are held in the stainless steel cell wall by enclosing it with a wrapper plate. During fabrication, a cut-to-length sheet of Boraflex was attached to the wrapper plate with adhesive applied in short lengths (up to 2 1/2" long) at a maximum of 16 places (8 per side) along the length of the Boraflex. The purpose of the adhesive was to provide temporary support during the spot welding process and not for long-term

binding. The wrapper provides an enclosure which protects the Boraflex from the flow of water, very much like that used in the original Boraflex qualification testing. Additionally, the wrapper enables the Boraflex panel to remain in place without the necessity of tightly clamping the panel in place.

In conclusion, the experience at Point Beach indicates that some physical changes may occur in Boraflex, but that the Boraflex will retain its neutron attentuation properties. Additionally, both testing of Boraflex and the experience at Quad Cities indicates that some shrinkage in Boraflex may occur, but that this shrinkage is limited to a maximum of 2 to 3% of the length of the Boraflex. The Quad Cities Boraflex panels had some gaps because the racks did not permit the Boraflex to shrink without cracking. Since there are differences in the manufacturing process of the Boraflex used at Quad Cities and Turkey Point, the experience at Quad Cities may not be applicable to Turkey Point. In any case, due to the small size and the random orientation of the gaps at Quad Citites, the gaps did not cause the k-effective of Quad Cities spent fuel pool to exceed the 0.95 limit.

Therefore, FPL considers that the Boraflex is acceptable for continued use at Turkey Point.

Question 2 Based on the recent information, provide any changes to the in-service surveillance program for Boraflex neutron absorbing material and describe the frequency of examination and acceptance criteria for continued use. Provide the procedures for testing the Boraflex material and interpretation of test data.

Response To confirm that the Boraflex at Turkey Point is acceptable for continued use, FPL will conduct two types of examinations of the Boraflex. First, as described in the Turkey Point Units 3 and 4 Spent Fuel Storage Facility Modification, Safety Analysis Report, dated March 14, 1984. Section 4.8, Testing and In-service Surveillance, FPL will conduct an in-service surveillance program. This program will evaluate both Region I and Region II Boraflex samples for the following:

I. Physical Characteristics

A. Examine the stainless steel jacket and note whether the material is smooth or exhibits any visible damage.

B. Examine the Boraflex poison sample and note whether the material is smooth

or exhibits any visible changes (color, pitting or cracking, etc.).

C. Measure specimen(s) weight and volume, and calculate its density.

D. Measure the hardness of the specimen(s).

II. Nuclear Characteristics

A. Take a neutron radiograph of the specimen(s) to determine the uniformity of boron distribution.

B. Perform attenuation measurement of the specimen(s), and determine the B_{10} loading. The minimum areal density of boron should be equal to or greater than 0.02 gm/cm^2 for Region I and 0.012 gm/cm^2 for Region II.

Second, FPL will conduct a surveillance program to detect any spatial distribution anomalies in the Boraflex panels. This program, called "Blackness Testing", will involve the use of a fast neutron source and thermal neutron detectors. The thermal neutron detectors will be connected to four chart recorders which will record the presence of thermal neutrons. The number of thermal neutrons will be low if the boron carbide is present in the Boraflex material. If gaps or voids are present, the number of thermal neutrons will increase and

be recorded by the chart recorders. This arrangement of instruments would detect gaps or anomalies in the Boraflex panels. The Blackness Testing technique was utilized successfully by Quad Cities to determine the existence of gaps in their spent fuel racks. FPL will perform the baseline testing in late July or early August for several storage cells in both Region I and Region II that have received the highest cumulated exposure to date. FPL will then retest these cells on a regular interval to be determined at a later date. This interval will be based on FPL's results and EPRI and industry data.

FPL's surveillance programs will be sufficient to detect any changes in the neutron attentuation properties of the Boraflex and any changes in the physical distribution of the Boraflex. As a result, these programs will assure that the Boraflex in the Turkey Point spent fuel racks will be acceptable for continued use.

<u>Question 3</u> Describe the corrective actions to be taken if degraded Boraflex specimens or absorber is found in the spent fuel pool.

Response

FPL will follow the industry efforts concerning the performance of Boraflex. EPRI, Bisco (the manufacturers of Boraflex) and several utilities are analyzing data as it becomes available and will notify the industry of the results. FPL will evaluate these results and determine whether any additional actions are warranted for the Turkey Point spent fuel racks.

A sensitivity study has been performed to determine whether the Boraflex material at Turkey Point would be acceptable if it develops gaps. As discussed above, tests and the Quad Cities surveillances indicate that 2% shrinkage could occur. If it is conservatively assumed that this shrinkage would cause gaps in the Turkey Point Boraflex, the shrinkage could result in a two or three inch gap. If it is postulated that such gaps would occur in every Boraflex panel at exactly the same location (which is an extremely conservative and unrealistic assumption based on the Quad Cities data), the attached curves show that the Turkey Point spent fuel pool would still maintain the required shutdown margin. This shutdown margin does not account for the 1950 ppm boron in solution which adds an additional 30%Δ k/k shutdown margin.

Therefore, should the Boraflex degrade, the spent fuel could still be stored at Turkey Point with the required shutdown margin.

ATTACHMENT

A study has been completed to determine the effect of gaps in BOROFLEX poison plates on spent fuel rack K_{eff}. The basis for this study was the Turkey Point Unit 3 Region 1 spent fuel storage racks.

Axial gaps in the BOROFLEX ranging from 0 to 10" were modeled explicitly using KENO. These gaps were modeled in one half of and in all of the poison plates in the rack.

The results from the KENO calculations were applied as adders to the originally calculated rack K_{eff} and uncertainties. The details of the calculation of the original K_{eff} with uncertainties are attached.

The KENO calculations and the original criticality analysis assume a maximum U-235 enrichment of 4.5 w/o. The results are presented in Figures 1 and 2.

It was also requested that the same type of data be provided with a maximum U-235 enrichment of 4.1 w/o assumed. The original criticality analysis included a study which showed the sensitivity of rack K_{eff} to fuel enrichment for the Region 1 spent fuel racks. This study was used to determine that the decrease in U-235 enrichment from 4.5 w/o to 4.1 w/o results in a 0.018 ΔK decrease in rack K_{eff}. This small change in fuel enrichment does not significantly effect the reactivity worth of the gaps in the poison plates. The data for the study using the 4.1 w/o fuel was produced by subtracting the 0.018 ΔK from the results of the 4.5 w/o fuel study. The results of this second study are presented in Figures 1 and 3.

The data presented in this report are the results of a detailed sensitivity study and are representative of the results that would come from a complete reanalysis of the Turkey Point Unit 3 Region 1 spent fuel storage racks.

The following text was taken directly from the Turkey Point criticality analysis report.

Based on the analysis describe above, the following equation is used to develop the final K_{eff} for the Turkey Point Region 1 spent fuel storage racks:.

$$K_{eff} = K_{nominal} + B_{method} + B_{part} + B_{mech} + ((ks_{nominal}^2) + (ks_{method})^2 + (ks_{mech})^2)^{1/2}$$

Where:

$K_{nominal}$ = nominal case KENO K_{eff} = 0.9150

B_{method} = method bias determined from benchmark critical comparisons = 0.0 ΔK

B_{part} = bias to account for poison particle self-shielding = .0025 ΔK

B_{mech} = bias to account for material thickness and construction tolerance = 0.00740 ΔK

$ks_{nominal}$ = 95/95 uncertainty in the nominal case KENO K_{eff} = 0.00401 ΔK

ks_{method} = 95/95 uncertainty in the method bias = 0.013 ΔK

ks_{mech} = 95/95 uncertainty associated with material thickness and construction tolerances = 0.00721 ΔK

Substituting calculated values in the order listed above, the result is:

$$K_{eff} = 0.9150 + 0.0 + 0.0025 + 0.00740 + ((0.00401)^2 + (0.013)^2 + (0.00721)^2)^{1/2} = 0.9403$$

FIGURE 1

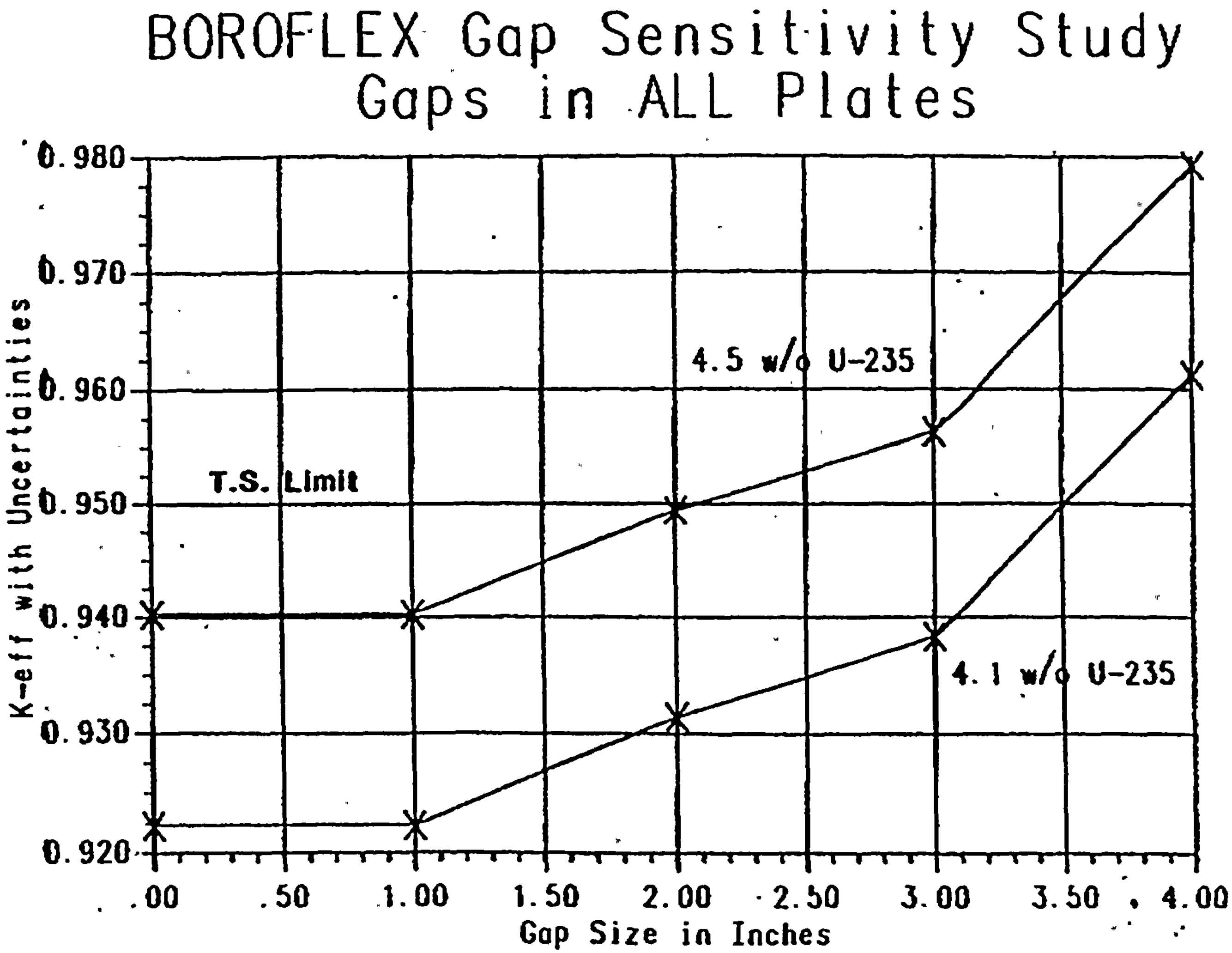
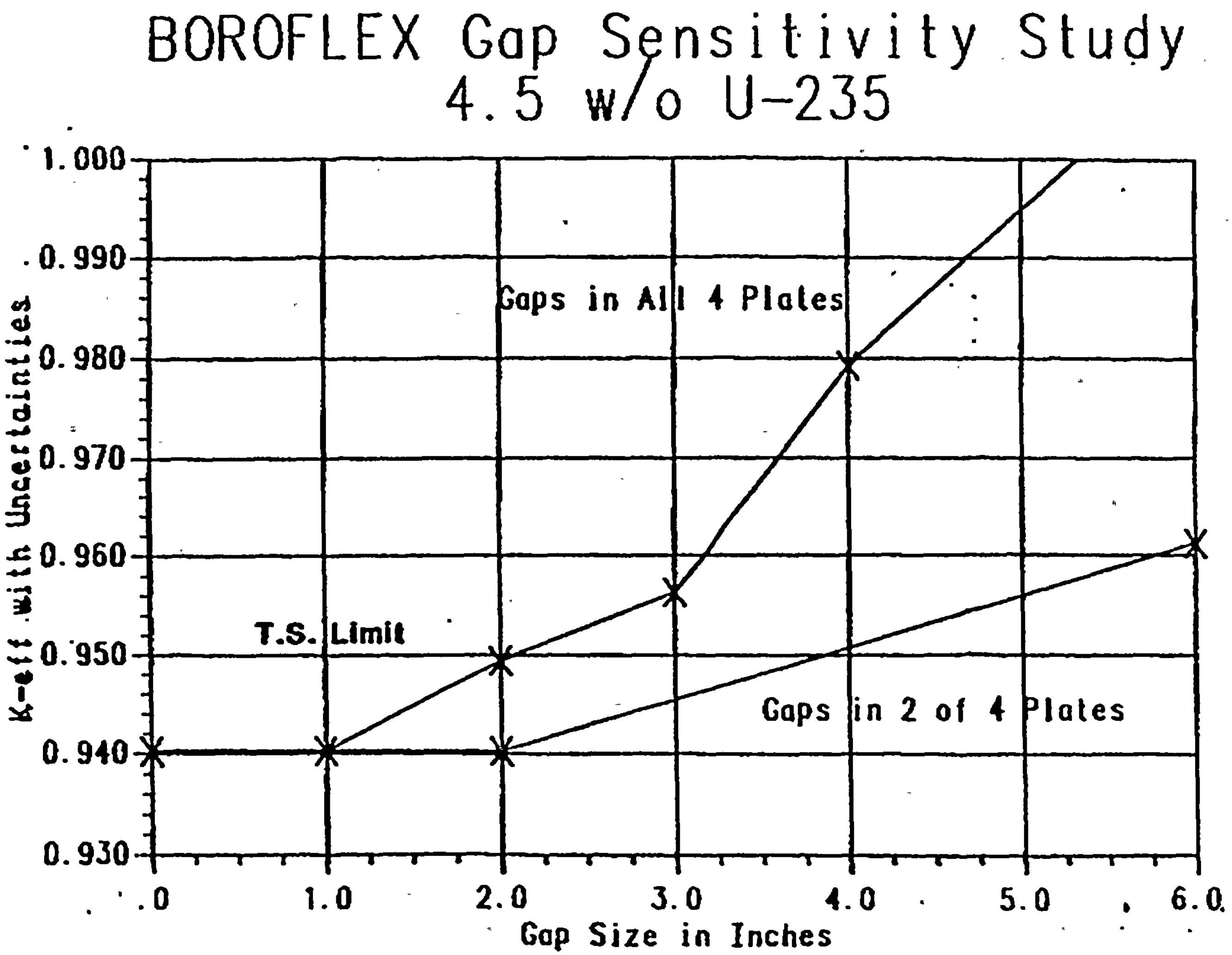
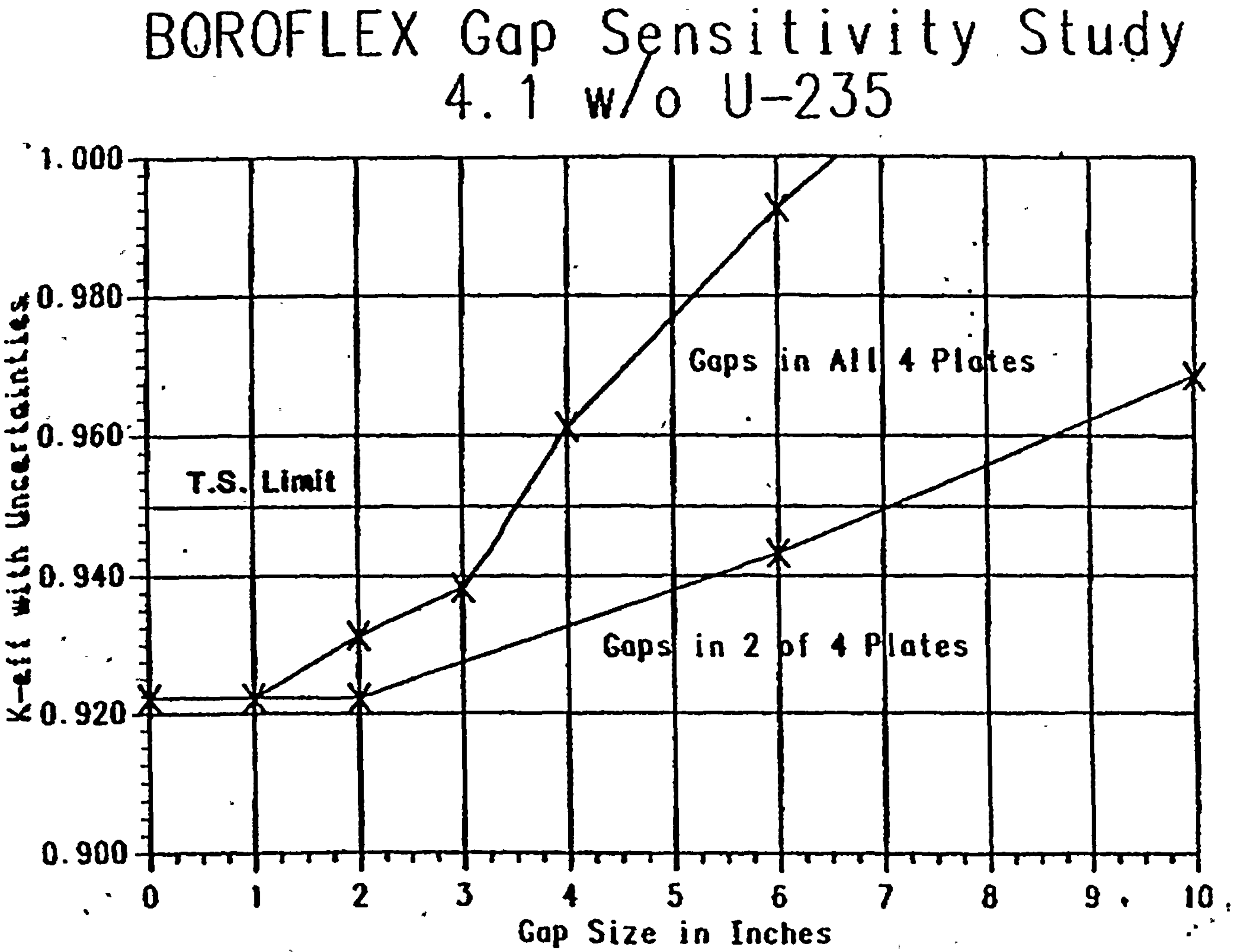

BOROFLEX Gap Sensitivity Study
Gaps in ALL Plates
K-eff with Uncertainties
0.980
0.970
0.960
0.950
0.940
0.930
0.920
4.5 w/o U-235
T.S. Limit
4.1 w/o U-235
.00
.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Gap Size in Inches

FIGURE 2



BOROFLEX Gap Sensitivity Study
4.5 w/o U-235
1.000
0.990
0.980
0.970
0.960
0.950
0.940
0.930
K-eff with Uncertainties
Gaps in All 4 Plates
T.S. Limit
Gaps in 2 of 4 Plates
.0
1.0
2.0
3.0
4.0
5.0
6.0
Gap Size in Inches

FIGURE 3


BOROFLEX Gap Sensitivity Study
4.1 w/o U-235
1.000
0.980
0.960
0.940
0.920
0.900
K-eff with Uncertainties
T.S. Limit
Gaps in All 4 Plates
Gaps in 2 of 4 Plates
0
1
2
3
4
5
6
7
8
9
10
Gap Size in Inches